SCIENCE.—SUPPLEMENT.

FRIDAY, NOVEMBER 13, 1885.

THE RESULTS OF SHAD PROPAGATION ON THE ATLANTIC COAST.

AT a recent meeting of the Biological society of Washington, Col. Marshall McDonald read a paper upon the necessity of artificial propagation, in relation to the maintenance of the shad fisheries. He argued that the shad fisheries depend upon artificial production for their maintenance. This theory was illustrated by a comparison of statistics for 1880 and 1885, and a consideration of the attendant conditions. The figures for 1880 were taken from the census reports; those for 1885 from a recent reconnoissance by experts, usually the same persons who made the census reports. He brought together the statistics of all the rivers of the Atlantic slope. The catch in each river fluctuates under local conditions. It is not true that shad, spawned in certain rivers, necessarily return to the same rivers. They remain, it is true, in the geographical area in which they were spawned, but may seek any fresh water within that area. It is only by taking the statistics of the rivers of the entire area that it could be determined whether there had been an actual increase or decrease. Table I. giving "Comparative statistics of the shad fisheries of the Atlantic rivers," was submitted.

While the commercial value of the increase was not large compared with the whole, that sum was ten times as great as the yearly sum spent by the fish commission upon the work of propagation.

In order to arrive at a measure of the increase or decrease of the shad fisheries of the Atlantic coast rivers, it is necessary to compare the aggregate catch in the principal rivers. Conclusions

TABLE I.

COMPARATIVE STATISTICS OF THE SHAD FISHERIES OF THE ATLANTIC COAST RIVERS FROM CAPE COD, MASS., TO CAPE HENRY, VA., FOR 1880 AND 1885.

	Number of shad taken in 1880.	Number of shad taken in 1885.	Per cent of increase or decrease.	Remarks.
Connecticut River and tributaries	268,608	215,000	25% Decrease.	The aggregate increased catch of shad in 1885 over 1880 amounted to—
Hudson River	781,628	1,174,028	33% Increase.	
Delaware River and Bay	735,300	1,148,496	36% Increase.	In quantity.....1,050,000 lbs.
Chesapeake Bay and its tributaries	2,084,600	1,632,600	21% Decrease.	In value.....$73,530.
Aggregate catch	3,870,136	4,170,124	7.8% Increase.	

TABLE II.

COMPARATIVE STATISTICS OF THE SHAD FISHERIES OF CHESAPEAKE BAY AND ITS TRIBUTARIES FOR 1880 AND 1885.

	Number of shad taken in 1880.	Number of shad taken in 1885.		Total number of shad taken in 1885.	Per cent of increase or decrease.	Remarks.
		In salt water	In fresh water			
By pound net fisheries in Chesapeake Bay outside of the mouths of the rivers	593,243	713,448	.....	713,448	20% Increase.	67% of all shad taken in the Chesapeake and its tributaries in 1885 were taken in salt or brackish water before reaching spawning grounds. The 33% taken by the river fisheries on, or in the vicinity of, their spawning grounds, being captured for the most part before they had spawned, it will be seen that we are dependent for natural reproduction upon the small number of shad that escape the pound nets and elude the energetic pursuit of the river fishermen.
Susquehannah River and minor tributaries at the head of Chesapeake Bay	614,000	50,000	162,161	212,161	65% Decrease.	
Potomac River	582,800	60,000	97,697	157,697	74% Decrease.	
Rappahannock River	134,000	220,000	30,000	250,000	86% Increase.	
York River (all salt water) catch, included in the pound net fisheries of the bay	.....	.....	.....	.....	.....	
James River	106,000	45,000	200,000	245,000	131% Increase.	
Minor tributaries of the Chesapeake on eastern shore of Maryland and Virginia	54,500	27,250	27,250	54,500	.....	
Aggregate catch	2,084,543	1,115,698	517,108	1,632,806	21% Decrease.	

based upon the fluctuations of catch in a single river are necessarily fallacious, since such fluctuations are due to local causes. So far as the shad is concerned, all the rivers draining into the Atlantic between Cape Cod and the capes of the Chesapeake, and the submerged continental borders lying between the coast line and the Gulf Stream, constitute a single zoölogical province, within the limits of which the migrations of the shad are confined.

In February and March, when their migrations into continental waters begin, the direction of their movements is largely determined by temperature conditions existing in the area in which they are. The principal migration may be into the Chesapeake, or it may be up the coast into the Delaware, the Hudson, and the Connecticut; but in either case the aggregate catch will furnish a just measure of increase or decrease. A comparison of the statistics of the fisheries for 1880 and 1885 (see table I.) shows a gain of nearly eight per cent in the aggregate catch. The significance of this, as showing the value and necessity of artificial propagation, will be better appreciated by considering the adverse conditions under which it has been accomplished:—

1. Access to suitable spawning grounds in fresh water is a physiological necessity.

2. Access in sufficient numbers to compensate by natural reproduction, waste by casualty or capture, is necessary to prevent the eventual destruction of our shad fisheries if we rely upon natural reproduction solely.

3. Existing adverse conditions limit natural reproduction, so that we cannot depend upon it to keep up supply.

(*a*) Dams in our rivers have curtailed the spawning areas to less than half of what they formerly were.

(*b*) The spawning grounds still accessible have been destroyed by the pollution of the waters, which are thus rendered unfit to sustain the delicate embryo shad.

(*c*) The change in the location of the fishing grounds, and the increasing proportion of shad taken year by year outside of the mouths of the rivers, or in the rivers before they have reached spawning grounds, has so reduced natural reproduction as to render it an insignificant factor in keeping up supply.

Under such conditions, the spawning area being limited, and the shad excluded from fresh water, without artificial propagation, the shad must soon be exterminated, or there must at least be such reduction as to render the fisheries unprofitable. Such a crisis was fast approaching in 1879, when the fish commission began the work of shad propagation. The work of artificial propagation has not only held the balance even, but resulted in a slight increase.

Colonel McDonald deprecated the methods employed in shad fishing, especially the use of pound nets. In the Connecticut River, where pound nets are used, the greater part of the catch is taken in salt water. In the Hudson, since the laws of New York do not permit fishing with pound nets, the river is not obstructed to the same extent as the Connecticut. In the Delaware, where an increase is shown, there are no pound nets. In the Chesapeake and its tributaries, with a decrease of 21 per cent, 713,000 of the shad caught this year, or more than one-half of the whole catch, were caught in the salt water of the bay. The pound nets begin at the capes, and extend to the mouth of the Potomac. Prior to 1871 the shad were taken entirely in fresh water, but now over one-half are caught in salt water. In the Potomac River nearly one-half of the catch is made in water where the fish cannot spawn. In the Rappahannock one-half the catch is in brackish water. In the York River the catch is practically below Gloucester Point. In the James River there are no pound nets, and in that river is an increase in the catch. While the fisheries in the Chesapeake Bay and its tributaries, as a whole, have fallen off 21 per cent, the decrease in the catch in certain rivers is much greater. The catch in the Susquehanna in 1880 was 614,000, against 212,000 in 1885; and in the Potomac, 552,857 in 1880, against 157,697 in 1885. The reason of this is obvious. In 1871 there were no pound nets in Chesapeake Bay, and no shad were taken until they entered fresh water. Gilling was not prosecuted so low down the river as now. In 1880 there were in Chesapeake Bay 180 pound nets set in the track followed by the shad along the western shore, and through these the shad had to run a gauntlet up to the mouths of the rivers. Now there are 1,000 pound nets, occupying the western shores of the bay, and excluding the fish from the fresh water. The effect of the salt-water fishery is to diminish natural reproduction, and to invoke artificial propagation as a necessary aid to the fisheries. If all shad were excluded from our rivers for three or four years, without artificial propagation, the species would be exterminated. Taking all the facts into consideration, and the inadequacy of natural reproduction to supply the annual loss, we must credit artificial reproduction not only with having maintained the fisheries where they were, but with an increase which repays ten times the cost of the work of shad propagation, as carried on by the U. S. fish commission and those of the several states.